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RADIUM MONITORING NETWORK

DATA RELEASE NUMBER 13

PUBLIC HEALTH SERVICE, DENVER, COLORADO

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RADIUM MONITORING NETWORK

DATA RELEASE NO. 13

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT
DENVER, COLORADO

JULY 1968

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16. Abstracts

This thirteenth data release report provides radium-226 and uranium results that supplement data from 12 previous reports dated October 1962 through January 1968. The tabular data indicate evidence of uranium mining and milling from analysis of composite water samples at stations of the Radium Monitoring Network of the Colorado River Basin Water Quality Control Project. The network is a surveillance system consisting of continuous surface water sampling at 27 locations throughout the basin. It assays the radiological content of river water over the entire basin.

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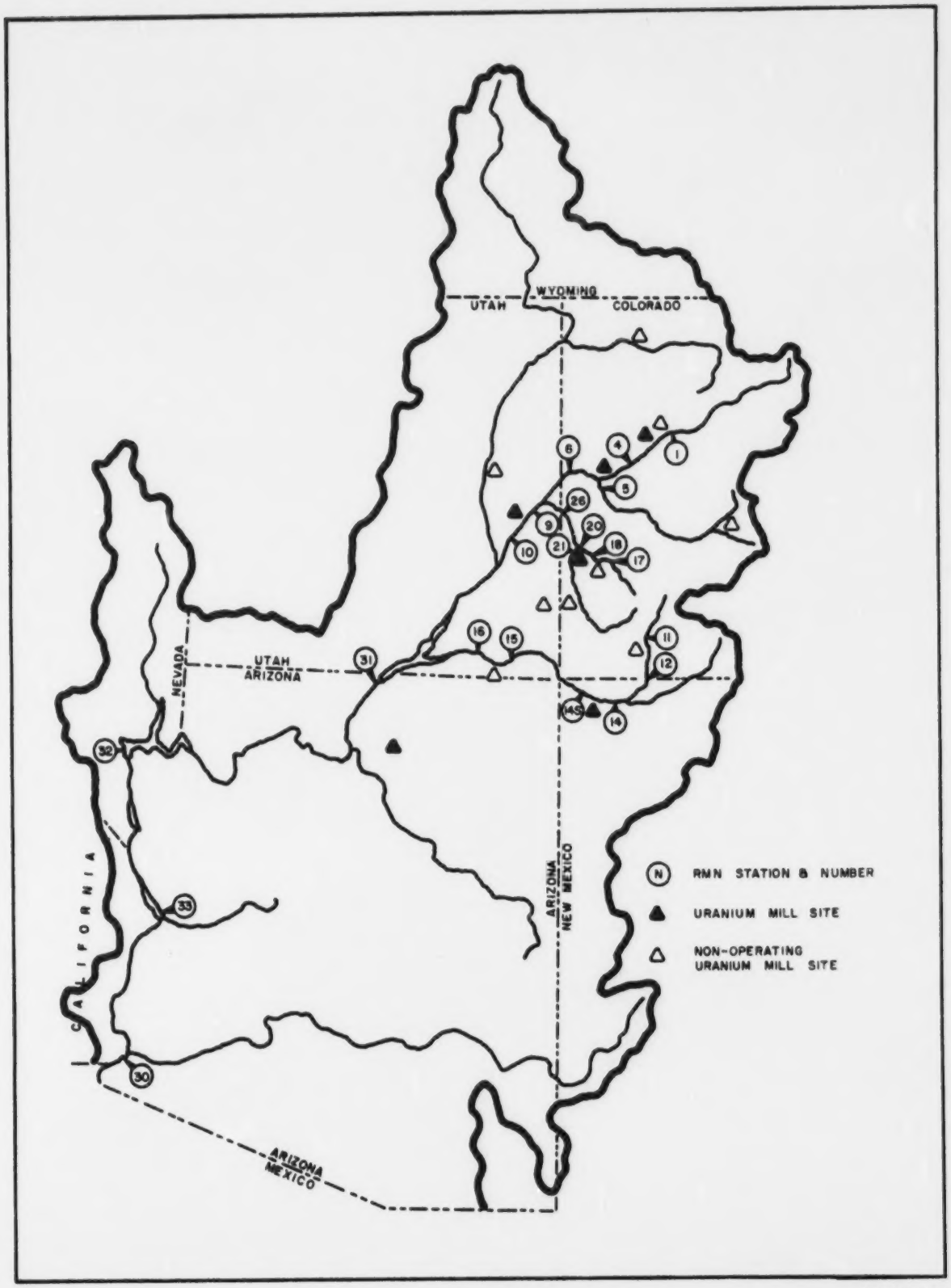

GPO 851-409

COLORADO RIVER BASIN RADIUM MONITORING NETWORK

COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

RADIUM MONITORING NETWORK DATA RELEASE NO. 13

INTRODUCTION

This is the thirteenth release of data collected through the Radium Monitoring Network, which is maintained by the Colorado River Basin Water Quality Control Project, Federal Water Pollution Control Administration. The purpose of this release is to supplement data given in the twelve previous releases dated October 1962 through January 1968.

A summary report of Radium Monitoring Network data collected through December 1963 was published in the November 1964 edition of Radiological Health Data, copies of which are now available through Colorado River Basin Water Quality Control Project Headquarters. A similar report of data collected through December 1964 was published in the November 1965 edition of the same periodical and reprints are available through the U. S. Government Printing Office.

The Radium Monitoring Network is a surface water surveillance system consisting currently of twenty sampling stations located on various streams and reservoirs throughout the Colorado River Basin. During initial stages of the surveillance program, the system consisted of twenty-seven sampling stations. The purpose of the network is to provide continuous monitoring of radioactivity concentrations of Basin surface water so that the contribution from uranium mining and milling industry waste discharges can be determined. Samples are analyzed for radium-226, uranium, gross alpha, gross beta, thorium (alpha), lead-210, and strontium-90 to provide a comprehensive picture of contributions of radiological contaminants to surface waters of the Colorado River Basin by the uranium industry and by fallout from the testing of weapons.

SAMPLING PROCEDURES

Depending on individual station parameters, Radium Monitoring Network (RMN) samples are collected as either automatic or grab samples. Grab samples are collected once or three times per week and automatic samples collected in 21-ml. portions every hour. The samples are sent as collected to the Colorado River Basin Water Quality Control Project Laboratory where they are composited and filtered through 0.45-micron membrane filters as soon as possible after the samples for the compositing period are received. After filtration, samples are acidified with 2% by volume of 12N HCl and radiochemical determinations are then performed on the filtered water.

SIGNIFICANT FIGURES

After a careful consideration of the accuracies and precisions involved in the various analytical procedures, it was decided to report

data to two significant figures except in those instances where the lower limit of detection was being approached. In the latter instances, only one significant figure is reported. The last significant figure is usually an estimate.

In averages, three figures are retained if the precision and significance of the averaged data justify such retention. Thus, the overall averages for radium-226 at stations 11 and 26 are reported, respectively, as 0.05 and 1.17 picograms per liter.

RESULTS

The Appendix contains the dissolved radium-226 and uranium data collected since the twelfth data release along with averages for this reporting period and for the previous year. A summary of all data on radium-226 and uranium is given in Table 1. Mean annual concentrations of radium-226 for each station are given in Table 2. Gross alpha, gross beta, lead-210, thorium (alpha), and strontium-90 data on samples collected through March 1967 were reported in Data Releases Nos. 7, 8, 10, 11, and 12.

Radium-226 and uranium concentrations at most stations continue to average well below recommended maximum concentrations. The Dolores River at Gateway, Colorado, and the San Miguel River below Uravan, Colorado, now carry average radium-226 concentrations of 1.81 and 4.05 picograms per liter, respectively. Radium-226 concentrations at five stations warrant comment.

Radium-226 concentrations in the San Miguel River below Uravan, Colorado, averaged 4.05 picograms per liter as compared with 2.10 for the previous year and with 1.33 for the long-term average. At Gateway, Colorado, radium-226 concentrations in the Dolores River averaged 1.81 picograms per liter as compared with 1.50 for the previous year and 1.17 for the long-term average. Deteriorations in quality have occurred at both of these stations. During this reporting period, uranium concentrations below Uravan averaged 24 micrograms per liter; at Gateway the average was 29 micrograms per liter.

The mean annual concentrations (Table 2) of radium-226 at stations above and below Moab, Utah, indicate that pollution from the mill at Moab increased noticeably during 1967. During the current reporting period, the mean radium-226 concentration at the upstream station was essentially unchanged from the values for the previous year and the previous reporting period; at the downstream station, the mean radium-226 concentration was up to 0.91 picograms per liter from 0.77 for the previous year and 0.46 for the previous reporting period. Uranium concentrations at the

upstream and downstream stations averaged 11 and 14 micrograms per liter; these values are somewhat higher than those for the previous year and previous reporting period.

In Data Release No. 9, attention was called to an elevation in the average radium-226 concentration in Lake Mead as compared to the long-term average. Data for the current reporting period and for 1967 indicate that the radium-226 concentrations are decreasing to values which are below the long-term average of 0.35 picograms per liter.

TABLE 1

RADIUM-226 AND URANIUM CONCENTRATIONS IN SURFACE WATERS OF THE COLORADO RIVER BASIN

Station Number and Location	Radium-226 Av.[a] pg/l	Radium-226 Range pg/l	Radium-226 No. of Analyses	Uranium Av.[a] µg/l	Uranium Range µg/l	Uranium No. of Analyses
Animas River						
11 above Durango, Colorado	0.05	0.00-0.11	75	1.2	0.1-2.9	69
12 Colorado-New Mexico State Line	0.24	0.03-1.5	124	3.2	0.0-18	82
Colorado River						
1 at Silt, Colorado	0.20	0.04-0.39	79	3.2	0.0-4.4	65
4 at DeBeque, Colorado	0.19	0.05-0.44	80	3.6	0.4-7.2	65
6 at Fruita, Colorado	0.18	0.09-0.40	74	8.5	2.0-14	65
9 above Moab, Utah	0.26	0.10-0.52	108	9.7	2.4-31	95
10 below Moab, Utah	0.47	0.16-7.2	104	11	3.0-22	91
31 at Page, Arizona	0.19	0.04-0.36	52	6.7	2.8-13	53
32 Lake Mead	0.35	0.21-0.60	61	7.9	5.0-11	61
33 Lake Havasu	0.36	0.26-0.44	63	7.9	5.4-11	63
30 at Yuma, Arizona	0.17	0.06-0.33	71	7.6	2.0-11	66
Dolores River						
21 at Bedrock, Colorado	0.44	0.03-1.4	78	10	0.1-35	65
26 at Gateway, Colorado	1.17	0.04-3.8	116	16	0.1-51	94
Green River						
28 below Maybell, Colorado	0.09	0.03-0.15	36	2.7	0.6-8.0	32
29 below Green River, Utah	0.09	0.05-0.15	29	5.0	1.6-7.6	26

TABLE 1(Contd)

RADIUM-226 AND URANIUM CONCENTRATIONS IN SURFACE WATERS OF THE COLORADO RIVER BASIN

Station Number and Location	Radium-226 Av.[a] pg/l	Radium-226 Range pg/l	Radium-226 No. of Analyses	Uranium Av.[a] µg/l	Uranium Range µg/l	Uranium No. of Analyses
Gunnison River						
24 above Gunnison, Colorado	0.05	0.01-0.08	43	1.2	0.0-2.6	33
25 below Gunnison, Colorado	0.04	0.01-0.09	46	2.3	0.4-4.3	33
5 at Grand Junction, Colorado	0.09	0.01-0.30	74	10	0.7-19	65
San Juan River						
13 above Farmington, N. M.	0.07	0.03-0.16	20	2.8	0.0-8.3	19
14 below Farmington, N. M.	0.07	0.03-0.21	68	2.9	0.3-9.0	67
14S below Shiprock, N. M.	0.08	0.03-0.28	165	9.1	0.1-93	161
15 above Mexican Hat, Utah	0.11	0.04-0.66	72	6.2	1.4-23	59
16 below Mexican Hat, Utah	0.12	0.01-0.84	150	8.5	0.8-35	132
San Miguel River						
17 above Naturita, Colorado	0.04	0.00-0.14	94	2.1	0.0-6.5	66
18 above Uravan, Colorado	0.21	0.03-1.2	126	5.8	0.8-63	95
20 below Uravan, Colorado	1.33	0.06-25	311	23	0.0-150	282

[a] Average concentration obtained from all data presented in this and previous data releases.

TABLE 2

MEAN ANNUAL CONCENTRATIONS OF Ra-226
IN WATER AT MONITORING NETWORK STATIONS, 1961-1967

Values in Picograms per Liter

RMN Station No.	Location	Years 1961	1962	1963	1964	1965	1966	1967
1	Colorado River at Silt, Colorado	0.18	0.15	0.23	0.25	0.16	0.20	0.20
4	Colorado River above DeBeque, Colorado	0.20	0.16	0.23	0.22	0.17	0.18	0.19
5	Gunnison River above Grand Junction, Colo.	--	0.07	0.11	0.12	0.07	0.09	0.08
6	Colorado River near Fruita, Colorado	--	0.17	0.21	0.18	0.17	0.16	0.17
9	Colorado River above Moab, Utah	0.34	0.24	0.29	0.27	0.19	0.26	0.28
10	Colorado River below Moab, Utah	0.41	0.33	0.54	0.32	0.27	0.39	0.93
11	Animas River at Durango, Colorado	0.05	0.05	0.06	0.05	0.04	0.05	0.05
12	Animas River at Colo.-N. M. State Line	0.37	0.37	0.23	0.13	0.09	0.09	0.09
13	San Juan River above Farmington, N. M.	--	0.08	0.07	0.04	--	--	--
14	San Juan River at Fruitland, New Mexico	--	0.12	0.12	0.07	0.06	0.05	0.06
14S	San Juan River below Shiprock, N. M.	--	0.11	0.12	0.09	0.06	0.05	--
15	San Juan River above Mexican Hat, Utah	0.18	0.15	0.13	0.14	0.07	0.08	0.08
16	San Juan River below Mexican Hat, Utah	0.34	0.24	0.16	0.09	0.07	0.07	0.08
17	San Miguel River above Naturita, Colo.	0.02	0.04	0.04	0.05	0.05	0.05	0.04
18	San Miguel River above Uravan, Colorado	0.14	0.21	0.33	0.14	0.16	0.13	0.12
20	San Miguel River below Uravan, Colorado	0.98	0,84	1.34	0.86	0.46	1.92	1.57
21	Dolores River at Bedrock, Colorado	0.85	0.39	0.45	0.61	0.28	0.33	0.50
22	Tomichi Creek above Gunnison, Colorado	0.02	--	--	--	--	--	--
24	Gunnison River above Gunnison, Colorado	0.03	0.05	0.05	0.05	0.04	--	--
25	Gunnison River below confluence of Tomichi Creek, Gunnison, Colorado	0.04	0.04	0.05	0.04	0.03	--	--
26	Dolores River at Gateway, Colorado	0.42	1.38	1.03	1.13	0.67	1.20	1.22
28	Yampa River below Maybell, Colorado	0.11	0.09	0.09	0.09	0.06	--	--
29	Green River below Green River City, Utah	--	0.06	0.10	0.09	--	--	--
30	Colorado River at U. S.-Mexican Border	--	0.15	0.17	0.18	0.16	0.16	0.17
31	Colorado River at Page, Arizona	--	--	0.25	0.25	0.17	0.15	0.14
32	Colorado River at (Lake Mead) Boulder City, Nevada	--	--	0.33	0.31	0.41	0.41	0.32
33	Colorado River at Metropolitan Water District Intake, Lake Havasu, Cal.-Ariz.	--	--	0.35	0.36	0.36	0.39	0.34

A P P E N D I X

Results of Radium-226 and Uranium Analyses of Samples
from Individual Radium Monitoring Network Stations
for Current Reporting Period

RMN Station 1: Colorado River at Silt, Colorado
Started: November 25, 1961
Type: Automatic Pump-Timer

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 30-October 28	0.24	3.0
October 28-December 2	0.26	4.2
December 2-December 23	0.27	3.4
1968		
January 6-February 3	0.25	3.5
February 3-March 2	0.23	3.2
Current reporting period:		
Mean	0.25	3.5
Previous year:		
Mean	0.20	2.7
Std. Dev.	0.08	0.9

RMN Station 4: Colorado River above DeBeque, Colorado
Started: November 21, 1961
Type: Automatic Pump-Timer

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 30-October 28	0.21	5.8
October 28-December 2	0.22	5.8
December 2-December 30	0.24	6.0
1968		
December 30-February 3	0.25	5.5
February 3-March 2	0.23	4.6
Current reporting period:		
Mean	0.23	5.5
Previous year:		
Mean	0.19	3.5
Std. Dev.	0.05	1.3

RMN Station 5: Gunnison River above Grand Junction, Colorado
Started: April 16, 1962
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
October 2-October 27	0.07	15
October 30-December 1	0.08	7.9
December 4-December 29	0.06	5.6
1968		
January 1-February 2	0.08	10
February 5-March 1	0.04	7.7
Current reporting period:		
Mean	0.07	9.2
Previous year:		
Mean	0.08	10
Std. Dev.	0.03	4

RMN Station 6: Colorado River near Fruita, Colorado
Started: April 16, 1962
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
October 2-October 27	0.17	14
October 30-December 1	0.16	9.1
December 4-December 29	0.13	7.3
1968		
January 1-February 2	0.14	7.5
February 5-March 1	0.13	8.1
Current reporting period:		
Mean	0.15	9.2
Previous year:		
Mean	0.18	8.5
Std. Dev.	0.05	2.5

RMN Station 9: Colorado River above Moab, Utah
Started: December 11, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 4-September 29	0.20	13
October 2-October 27	0.17	14
October 30-December 1	0.41	11
December 4-December 29	0.33	8.7
1968		
January 1-February 2	0.32	9.3
February 5-March 1	0.26	9.1
Current reporting period:		
Mean	0.28	10.8
Previous year:		
Mean	0.26	9.6
Std. Dev.	0.09	2.7

RMN Station 10: Colorado River below Moab, Utah
Started: December 11, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 4-September 29	1.12	18
October 2-October 27	0.96	18
October 30-December 1	0.99	14
December 4-December 29	1.1	11
1968		
January 1-February 2	0.72	10
February 5-March 1	0.57	10
Current reporting period:		
Mean	0.91	13.5
Previous year:		
Mean	0.77	12
Std. Dev.	0.82	4

RMN Station 11: Animas River at Durango, Colorado
Started: July 17, 1961
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September	0.06	1.4
October 23-November 13	0.06	2.1
November 20-December 4	0.04	2.3
December 8-December 23	0.04	1.7
1968		
January 5-February 2	0.05	1.2
February 16-March 1	0.05	1.4
March 8-March 29	0.05	1.2
Current reporting period:		
Mean	0.05	1.6
Previous year:		
Mean	0.05	1.2
Std. Dev.	0.01	0.7

RMN Station 12: Animas River at Colorado-New Mexico State Line
Started: January 19, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 4-September 30	0.12	2.2
October 1-October 22	0.11	3.6
October 28-November 30	0.08	3.5
December 2-December 30	0.08	2.9
1968		
January 2-January 31	0.09	2.5
Current reporting period:		
Mean	0.10	2.9
Previous year:		
Mean	0.09	2.2
Std. Dev.	0.02	0.8

RMN Station 14: San Juan River at Fruitland, New Mexico
Started: August 1, 1962
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
October 2-October 23	0.05	4.3
October 30-November 27	0.11	4.1
December 4-December 25	0.07	3.4
1968		
January 1-January 29	0.08	3.7
February 5-February 26	0.05	2.7
March 4-March 25	0.06	3.2
Current reporting period:		
Mean	0.07	3.6
Previous year:		
Mean	0.05	3.2
Std. Dev.	0.01	1.3

RMN Station 15: San Juan River above Mexican Hat, Utah
Started: December 11, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 3-September 30	0.10	5.2
October 4-October 29	0.09	8.5
November 1-December 3	0.06	6.6
December 6-December 29	0.08	6.2
1968		
February 6-March 1	0.09	6.0
Current reporting period:		
Mean	0.08	6.5
Previous year:		
Mean	0.08	5.4
Std. Dev.	0.02	1.6

RMN Station 16: San Juan River below Mexican Hat, Utah
Started: December 11, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 3-September 30	0.10	5.8
October 4-October 29	0.10	9.0
November 1-December 3	0.07	8.3
December 6-December 29	0.06	5.8
1968		
February 6-March 1	0.08	6.6
Current reporting period:		
Mean	0.08	7.1
Previous year:		
Mean	0.08	5.2
Std. Dev.	0.04	1.3

RMN Station 17: San Miguel River above Naturita, Colorado
Started: October 28, 1961
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
October 2-October 23	0.04	3.1
October 30-November 26	0.03	3.8
December 3-December 24	0.04	5.1
1968		
December 31-January 28	0.04	2.8
February 4-February 25	0.02	3.3
March 3-March 24	0.03	3.3
Current reporting period:		
Mean	0.03	3.6
Previous year:		
Mean	0.04	2.7
Std. Dev.	0.01	1.0

RMN Station 18: San Miguel River above Uravan, Colorado
Started: October 27, 1961
Type: Automatic Pump-Timer

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 30-October 30	0.11	3.7
October 30-December 3	0.08	5.0
December 3-December 31	0.06	5.2
1968		
December 31-February 4	0.09	5.2
February 4-March 3	0.09	5.0
Current reporting period:		
Mean	0.09	4.8
Previous year:		
Mean	0.12	3.9
Std. Dev.	0.05	1.1

RMN Station 20: San Miguel River below Uravan, Colorado
Started: October 9, 1961
Type: Automatic Pump-Timer

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
October 2-October 9	0.47	23
October 7-October 14	0.53	9.8
October 16-October 23	0.48	5.5
October 23-October 30	1.3	8.9
October 30-November 6	1.0	14
November 6-November 13	1.8	3.5
November 13-November 20	2.7	11
November 20-November 26	4.8	16
November 26-December 3	1.8	28
December 3-December 10	1.6	55
December 10-December 17	5.1	45
December 17-December 24	5.2	37
December 24-December 31	4.7	36
1968		
December 31-January 7	7.2	51
January 7-January 14	20	94
January 21-January 28*	2.6	32
January 21-January 28*	3.6	9.8
January 28-February 4	5.1	17
February 4-February 11	9.4	11
February 11-February 18	6.2	11
February 18-February 25	1.9	5.7
February 25-March 3	1.7	4.6
Current reporting period:		
Mean	4.05	24
Previous year:		
Mean	2.10	15
Std. Dev.	3.67	18

* This sample may have been mismarked and may be that for January 14-January 21.

RMN Station 21: Dolores River at Bedrock, Colorado
Started: October 30, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 4-September 27	0.62	10
October 2-October 27	0.83	14
October 30-December 1	0.78	15
December 4-December 29	0.54	14
1968		
January 1-February 2	0.33	7.4
February 5-March 1	0.16	7.0
Current reporting period:		
Mean	0.54	11.2
Previous year:		
Mean	0.42	8.7
Std. Dev.	0.22	3.7

RMN Station 26: Dolores River at Gateway, Colorado
Started: October 30, 1961
Type: Three grab samples per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September 5-September 30	0.82	19
October 2-October 27	0.85	36
October 31-December 4	1.4	30
December 6-December 30	1.3	32
1968		
January 1-February 2	2.7	25
February 5-March 1	3.8	31
Current reporting period:		
Mean	1.81	29
Previous year:		
Mean	1.50	25
Std. Dev.	0.54	14

RMN Station 30: Colorado River at U. S.-Mexican Border
Started: July 30, 1962
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
October 2-October 27	0.15	5.8
October 30-December 1	0.12	6.0
December 4-December 29	0.20	5.6
1968		
January 1-February 2	0.17	7.2
February 12-March 1	0.12	7.4
March 4-March 29	0.15	7.5
Current reporting period:		
Mean	0.15	6.9
Previous year:		
Mean	0.16	5.7
Std. Dev.	0.03	1.7

RMN Station 31: Colorado River at Page, Arizona
Started: May 1, 1963
Type: 300-ml. composite per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
September	0.20	4.4
October	0.18	5.5
November	0.17	5.6
December	0.15	5.6
1968		
January	0.13	6.8
February	0.16	7.4
Current reporting period:		
Mean	0.17	5.9
Previous year:		
Mean	0.12	5.3
Std. Dev.	0.06	1.2

RMN Station 32: Colorado River at (Lake Mead) Boulder City, Nevada
Started: March 11, 1963
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
October 2-October 24	0.27	7.3
October 30-November 27	0.27	6.8
December 4-December 26	0.36	7.1
1968		
January 2-January 29	0.26	7.0
February 5-March 18	0.23	7.8
March 4-March 25	0.23	6.8
Current reporting period:		
Mean	0.27	7.1
Previous year:		
Mean	0.33	6.5
Std. Dev.	0.05	0.8

RMN Station 33: Colorado River at Metropolitan Water District Intake, Lake Havasu, California-Arizona
Started: January 7, 1963
Type: One grab sample per week

Date	Radium-226 pg/liter	Uranium µg/liter
1967		
October 2-October 23	0.32	6.8
October 30-November 27	0.31	7.4
December 11-December 25	0.28	7.1
1968		
January 1-January 29	0.28	7.3
February 10-February 26	0.28	7.6
March	0.28	6.6
Current reporting period:		
Mean	0.29	7.1
Previous year:		
Mean	0.35	7.1
Std. Dev.	0.02	0.8